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(54) MALE ELECTROFORMING MANDREL

(71) We, XEROX CORPORATION of Rochester, New York 14603, United States of America, a Body Corporate organised under the laws of the State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to electroforming mandrels. More particularly, this invention relates to cylindrical male electroforming mandrels.

Nickel belts suitable for use as zerographic belt substrates have been produced by electroforming a layer of nickel on a cylindrical male mandrel. Hitherto, the mandrels used for this purpose have been fabricated by coating a cylindrical aluminium forging first with various metallic electrodeposits for adhesion and leveling and then a fairly thick top layer of chromium which is ground and polished to achieve the desired dimensions and surface finish. It has been found that this technique for making the mandrels is slow and expensive and in many cases the layer of top chromium is pitted because of its thickness. Also, it has been found that if the surface of the mandrel becomes damaged during subsequent use all the coatings must be removed and replaced with a new series of coating.

Accordingly, it is an object of this invention to provide a new and improved cylindrical male electroforming mandrel.

It is another object of this invention to provide a new and improved method for making a cylindrical male electroforming mandrel.

It is still another object of this invention to provide a cylindrical male electroforming mandrel that can be used to electroform nickel belts suitable for use as zerographic belt substrates.

It is yet still another object of this invention to provide a cylindrical male electroforming mandrel that is relatively easy and inexpensive to make and can be repaired easily if damaged.

According to the present invention, there is provided a cylindrical male electroforming mandrel comprising; an aluminium cylinder; a nickel sleeve removably mounted around said aluminium cylinder; and a thin layer of a metallic material on the outer surface of the nickel sleeve, said metallic material being passive with respect to the materials to be used in electroforming on said mandrel.

The mandrel may be made by making the nickel sleeve and shrink fitting the nickel sleeve over the cylindrical aluminium core and coating the nickel sleeve with the layer of passive material. The coating of passive material can either be applied before or after the nickel sleeve is shrunk fit over the cylindrical aluminium core. One of the principal features of the mandrel made according to this invention is that the nickel sleeve is removable and hence can be replaced if it becomes damaged or worn.

A mandrel, and a method of making the mandrel, in accordance with the invention will now be described, by way of example, with reference to the accompanying drawing.

In the drawing the sole figure is a perspective view, partly in section, of a cylindrical male electroforming mandrel constructed according to this invention.

Referring now to the drawing there is shown a cylindrical male electroforming mandrel 11. The mandrel 11 includes a cylindrical aluminium forging 12. Shrunk fit over the forging 12 is an electroformed nickel sleeve 13. The outer surface of the nickel sleeve 13 is coated with a thin layer of chromium 14. The thickness of the electroformed nickel sleeve 13 is between 0.010 inches and 0.060 inches and the thickness of the layer of chromium 14 is between 0.00015 to 0.001 inches. The outside diameter of the article that is to be eventuallv electroformed on the mandrel 11 can be as large as 20 inches or even larger. The method of making the mandrel involves making the cylindrical aluminium forging, making the nickel sleeve, mounting the nickel sleeve on the cylindrical aluminium forging and coating the nickel sleeve with chromium. The aluminium cylindrical forging is made using any well known forging technique. The nickel sleeve is made by electroforming on the inside surface of a female master mandrel. The female master mandrel may be made of stainless steel..The nickel sleeve is made to a thickness of between 0.010 inches and 0.060 inches. The nickel sleeve is removed from the female master mandrel by heating the female master mandrel, spray cooling the nickel sleeve, and then slipping the nickel sleeve out from within the female master mandrel. The nickel sleeve is shrunk fit over the cylindrical aluminium forging. This is achieved by heating the nickel sleeve, chilling the cylindrical aluminium forging, and then slipping the nickel sleeve over the cylindrical aluminium forging. After the nickel sleeve is mounted on the cylindrical aluminium forging, a thin layer of chromium (i.e., between 150 x 10^{-6} to 0.001 inches thick) is deposited on its outer surface. Alternatively, the layer of chromium can be deposited on the nickel sleeve before the nickel sleeve is mounted on the cylindrical aluminium forging. The layer of chromium may be deposited by electroplating or by other similar means.

Since the layer of chromium on the nickel sleeve is relatively thin, it does not significantly change the surface finish or size of the nickel sleeve and the likelihood of pitting is reduced to a minimum. Since the outer surface finish and dimensions of the nickel sleeve are transferred to it from the female master mandrel, subsequent grinding and polishing of the nickel sleeve to size is eliminated, and since the nickel sleeve is shrunk fit over the aluminium forging, additional metallic deposits for adhesion of the nickel to the aluminium are not needed or used.

One of the principal advantages of the mandrel made according to this invention is that if the nickel sleeve becomes damaged during subsequent use it can simply be removed from the aluminium forging and replaced with another nickel sleeve. One way of removing the nickel sleeve from the aluminium forging is by immersing the mandrel in liquid nitrogen and then slipping the nickel sleeve off the aluminium forging.

WHAT WE CLAIM IS:—

1. A male electroforming mandrel comprising:
(a) an aluminium cylinder;
(b) a nickel sleeve removably mounted around said aluminium cylinder; and
(c) a thin layer of a metallic material on the outer surface of the nickel sleeve, said metallic material being passive with respect to the material to be used in electroforming on said mandrel.

2. The mandrel of claim 1 comprising a cylindrical aluminium forging and a chromium coated electroformed nickel sleeve shrunk fit over the cylindrical aluminium forging.

3. The mandrel of claim 2 wherein said chromium coating has a thickness of between 0.00015 and 0.001 inches.

4. The mandrel of any one of claims 1 to 3 wherein said nickel sleeve has a thickness of between 0.010 and 0.060 inches.

5. A method of making a male electroforming mandrel comprising:
(a) providing an aluminium cylinder;
(b) making a nickel sleeve having an inside diameter slightly smaller than the outside diameter of the aluminium cylinder:
(c) mounting the nickel sleeve around the aluminium cylinder by shrink fitting it thereon; and
(d) coating the outer surface of the nickel sleeve with a layer of chromium either before or after mounting the nickel sleeve around the aluminium cylinder.

6. The method of claim 5 wherein the aluminium cylinder is a cylindrical aluminium forging and the nickel sleeve is electroformed in a cylindrical female master mandrel.

7. The method of claim 5 or claim 6 wherein said chromium coating has a thickness of between 0.00015 and 0.001 inches.

8. The method of any one of claims 5 to 7 wherein said nickel sleeve has a thickness of between 0.010 and 0.060 inches.

9. A male electroforming mandrel substantially as hereinbefore described with reference to the accompanying drawing.

10. A method of making a male electroforming mandrel substantially as hereinbefore described with reference to the accompanying drawing.

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1365132 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*